Characterization of Farming and Livestock Production Systems and the Potentials to Enhance Productivity through Improved Feeding in the Subalpine Highlands of Amhara region, Ethiopia

Solomon G., Aschalew T., Lemma W.Y., Beneberu T., Shenkute G.

ARARI, Debre Birhan Agricultural Research Center, Ethiopia

Introduction

The subalpine highlands of Amhara region are characterized by extreme cold and frosty climate, rugged terrain, degraded soil and unreliable crop production. Livestock, particularly sheep production is the mainstay of farmers' livelihoods. Livestock production is constrained by ecological, technical and economic limitations which result in severe feed shortages. Thus, the objective of the current study was to assess feed resource availability and utilization using a feed assessment tool (FEAST) within the context of the overall farming and livestock production systems and to determine the potential of site-specific feed interventions in selected areas within the subalpine highlands.

Methodology

Study site

The surveys were conducted in Menz-Gera-Gera and Angolela-Tera Districts. They are located in North Shoa zone of Amhara state. Menz-Gera-Gera, which lies 300 km from Addis Ababa represents areas where crop production is unreliable and the livelihoods depend predominantly on sheep production. It is less accessible to input and product markets. Angolela-Tera lies 120 km from Addis Ababa. Due to its proximity to markets, it is more favorable for cropping. Sheep production and dairying are equally important as the district is located along the Debre Birhan-Addis milk shed.

Sampling method

Selection of villages

Two *Kebele*s (villages) in each district were selected for the survey based on their proximity to the capital town of the District. In Menz-Gera-Gera, the *Kebele*s selected were Dargegne and Sinamba. They are located 10.24°N, 39.44°E and 10.18°N, 39.37°E with altitudes of 3354m and 3040m above sea level (asl) respectively. In Angolela-Tera, Chefanen and Cheki were selected. They are located 9.32°N, 39.27°E and 9.28°N, 39.23°E with altitudes of 2769m and 2845m asl respectively.

Selection of participants

The criteria for selection of participants included gender, age and wealth classes based on land holdings.

Survey structure and format

Two tools were used for the survey. A group discussion using Participatory Rural Appraisal was conducted in each *Kebele* to describe the agricultural production systems and feed resource availability and utilization. A total of 12-15 farmers were selected from each *Kebele* for the focused group discussion. A quantitative questionnaire was administered to three key informants, selected from the focus groups, to assess overall feed availability, quality and seasonality. The surveys were conducted from 24 to 30 April, 2012.

Data analysis

The FEAST Excel macro program (www.ilri.org/feast) was used for data analysis. Narrative responses collected from the group discussions were examined and reported.

Major Findings

Overview of the farming systems

The farming systems for Menz-Gera-Gera and Angolela-Tera districts are described comparatively. The farmers in both Menz-Gera-Gera and Angolela-Tera are entirely smallholders with subsistence mode of production. However, in Menz-Gera-Gera, the average farm size is smaller and the percentage of landless farmers is higher than in Angolela-Tera (Table 1). The average household sizes in Menz-Gera-Gera (5.5) and Angolela-Tera (6.5) are comparable.

Table 1: Percentage of households that fall into various land size categories in Menz-Gera-Gera (A) and Angolela-Tera (B)

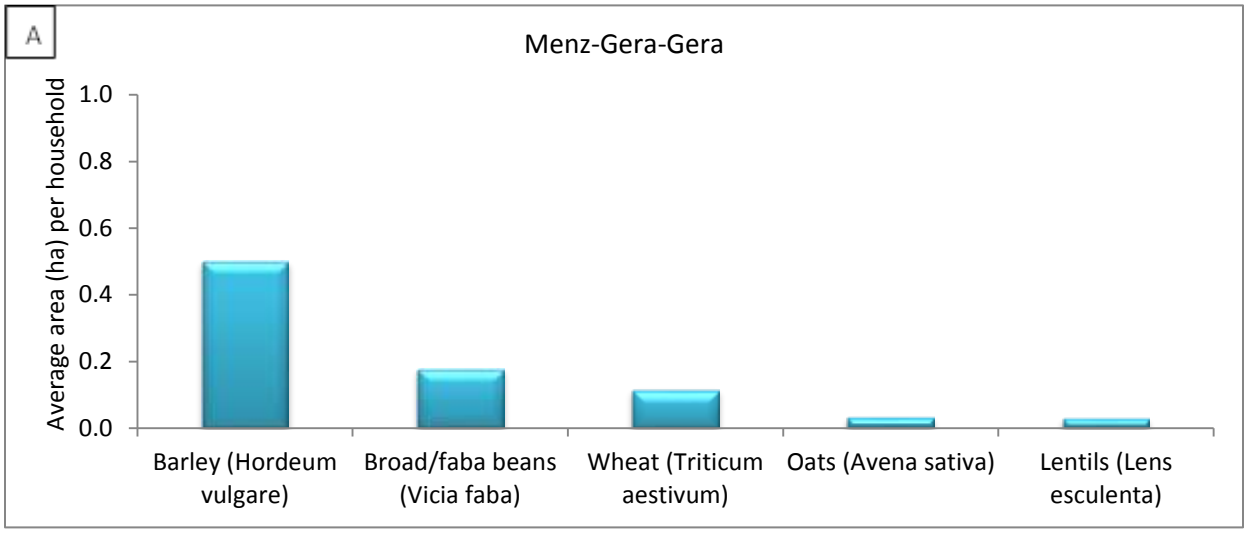
A

Category of farmers	Range of land size (ha)	% of households that fall into the category
Landless	0	10
Small	Up to 0.5	15
Medium	0.5 – 1.0	70
Large	More than 1.0	5

Category of farmers	Range of land size (ha)	% of households that fall into the category
Landless	10	2
Small	Up to 0.5	3
Medium	0.5 – 1.0	75
Large	More than 1.0	20

There are two main rainy seasons, the main season (*meher,* June/July to December) and a short season (*belg,* February to May/June). The *belg* season has in the past years become highly unreliable. Irrigation is available to 5% and 23% of the households in Menz-Gera-Gera and Angolela-Tera respectively. The major crops grown and the average area for each crop in the two districts are shown in Figure 1.

Agricultural activities in both districts do not commonly require more than family labor. Farmers with large land holdings who may need extra labor get it through the traditional labor sharing arrangement (*wonfel*, *jige*) or hire it at a cost of approx. 25 Birr (USD 1.4) in Menz-Gera-Gera and 55 Birr (USD 3.2) in Angolela-Tera. Labor is mainly required during planting (August) and crop and hay harvesting (October-November).



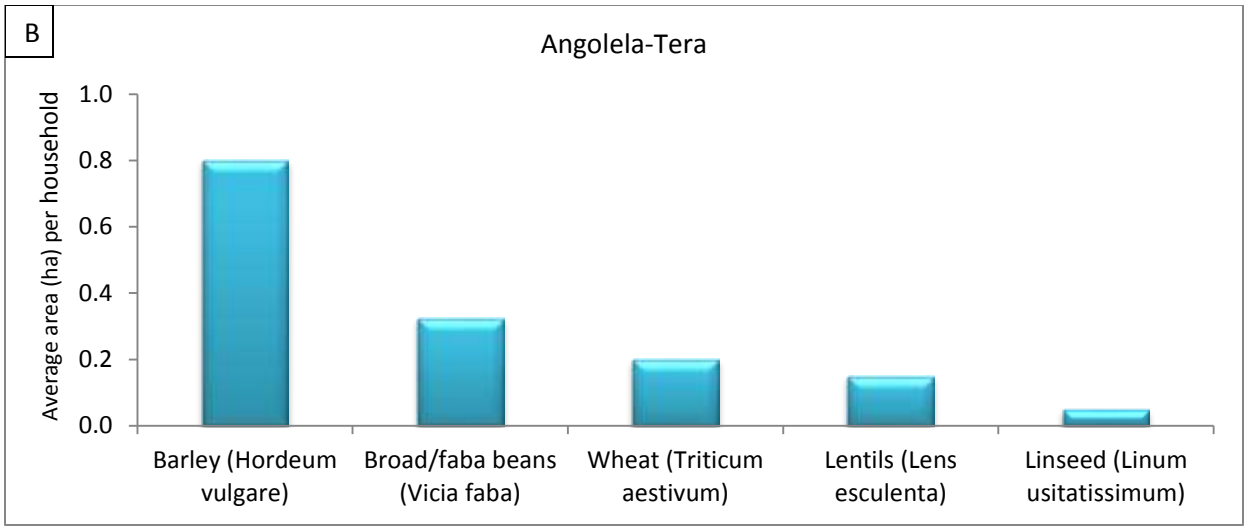
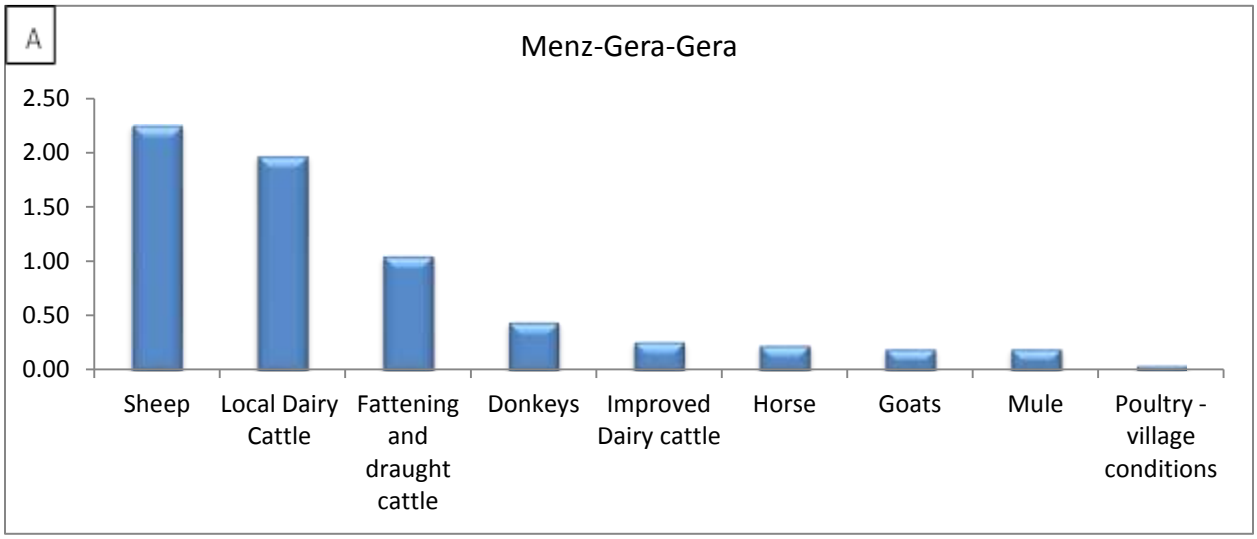


Figure 1: Average area (ha) of dominant arable crops per household in Menz-Gera-Gera (A) and Angolela-Tera (B)

Livestock production systems

The proportion of households that keep sheep, local and improved dairy cows are 98%, 60-80% and 2.5% in Menz-Gera-Gera and 96%, 98-100% and 24.9% in Angolela-Tera. The relative importance of sheep rearing in Menz-Gera-Gera and improved dairying in Angolela-Tera can also be observed from the average holdings of these species as shown in Figure 2. Goats are kept by 10-40% in Menz-Gera-Gera and 0-2% of the households in Angolela-Tera. All households keep chicken. The contribution of livestock production is much higher relative to other farm and off-farm activities as shown in Figure 3.



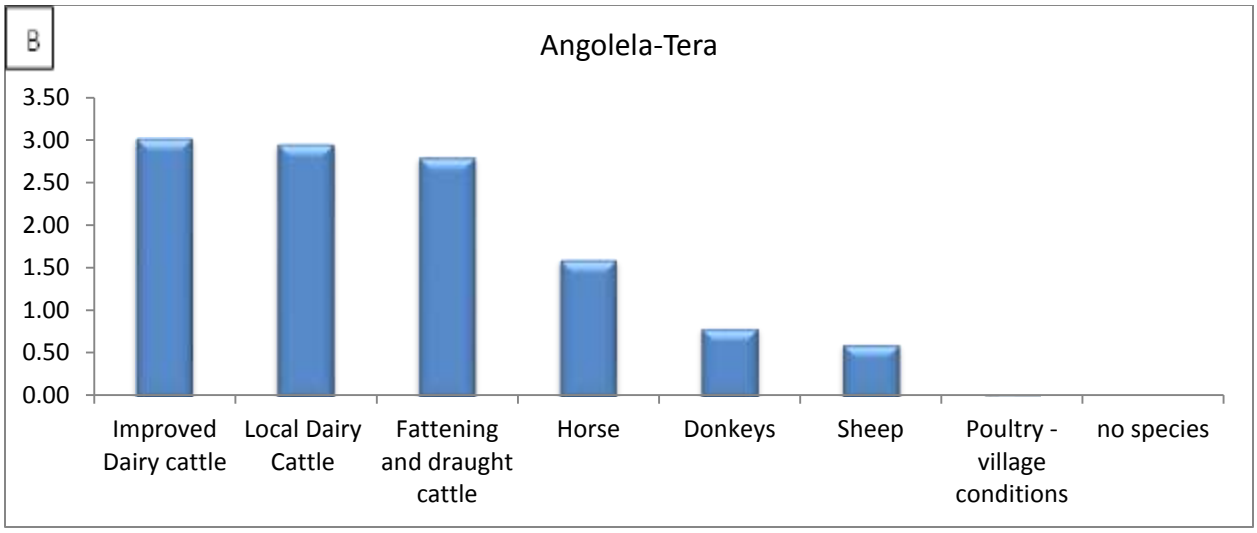


Figure 2: Average livestock species holdings per household in Tropical Livestock Units (TLU) in Menz-Gera-Gera (A) and Angolela-Tera (B)

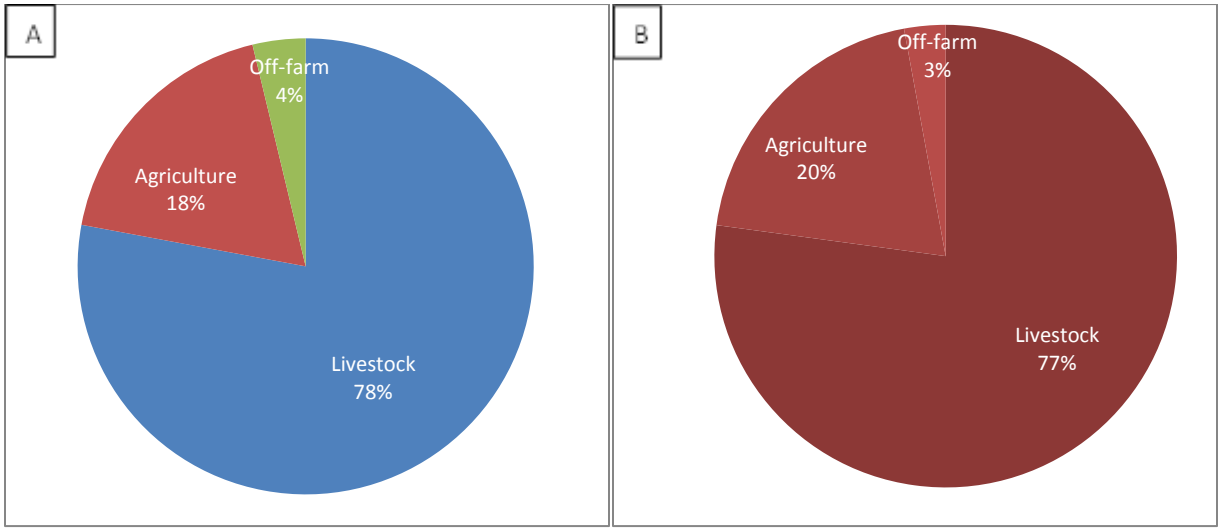


Figure 3: Primary contributors to household income in Menz-Gera Gera (A) and Angolela-Tera (B)

The livestock feeding management in Menz-Gera-Gera is largely based on grazing in communal lands. Dairy cows and oxen are supplemented with crop residues, hay and oats during the dry season. Feed processing is limited to chopping of crop residues. There is no concentrate feeding. Sheep rarely receive supplementary feeds, except during fattening. Routine health services are not accessible to some villages except occasional vaccination. AI services are not accessible to most farmers or are not efficient with the rate of repeat services at 2-3 times. Each service costs 4 Birr (USD 0.2). Farmers rely mostly on free natural service using local village bulls. In Angolela-Tera, some farmers stall feed improved dairy cows and fattening animals using urea-treated straws and mixed rations containing crop residues, wheat bran, noug cake and salt during the dry season (December-June). Veterinary service is available, but

costly and ineffective due to rogue traders. Farmers are not satisfied with the rate of repeat service (2-3 times) and most resort to natural mating using Holstein Friesian bulls at the cost of maximum 20 Birr (USD 1.2).

Feed resources: Availability, quality, seasonality

The feed resources in Menz-Gera-Gera district include natural pasture (grazing), cereal and legume crop residues, hay, green fodders (mainly weeds) and planted fodder (vetch and oat). These feeds are either obtained from communal lands (natural pasture) and private lands as by-products (crop residues and weeds), produced (planted fodder and hay) or are purchased (crop residues, hay and green fodder accounting for 55, 41 and 6% of the feed purchased). Overall feed availability and quality is low because communal grazing lands are degraded, only few farmers produce cultivated fodder on small pieces of land (0.03 ha), crop residue yields are low due to crop failures, and commercial concentrates are unavailable. The major feed resources are naturally occurring feeds either collected (hay, weeds) or used *in situ* (grazing). The relative contributions of the different feed sources to the total dry matter (DM), metabolizable energy (ME) and crude protein (CP) contents of the total diet are shown in Figures 4 - 6. There is a seasonal variation in the contribution of these feeds as depicted in Figure 7. Generally feed availability is high during the rainy season (August - October) and crop harvesting period (November - January), the major contributors being grazing/green forages and crop residues/hay, respectively.

The available feed resources in Angolela-Tera are similar to Menz-Gera-Gera District. However, more fodder crops (vetch, oats, lucerne and cannary grass) on a larger area (0.38 ha) are grown and there is a better practice of concentrate use than in Menz-Gera-Gera because of the higher level of improved dairying in the Debre Birhan-Addis milk shed. Commercial concentrates (wheat bran and noug cake) account for 83% of the feeds purchased, the remaining 17% being hay.

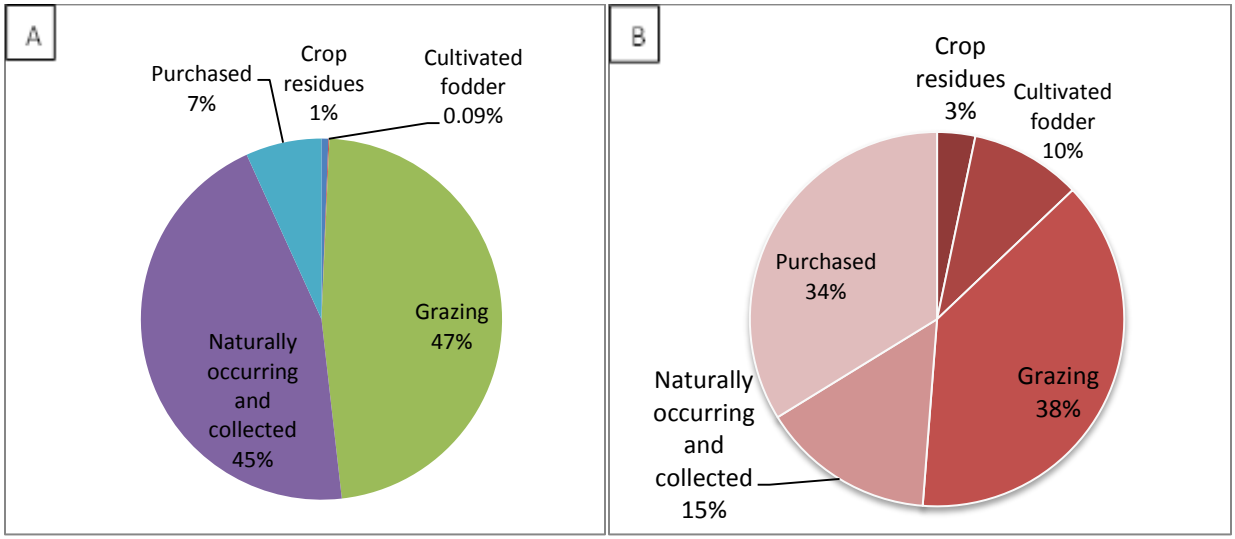


Figure 4: The contribution of feeds to total dry matter content in diets in Menz-Gera-Gera (A) and Angolela-Tera (B)

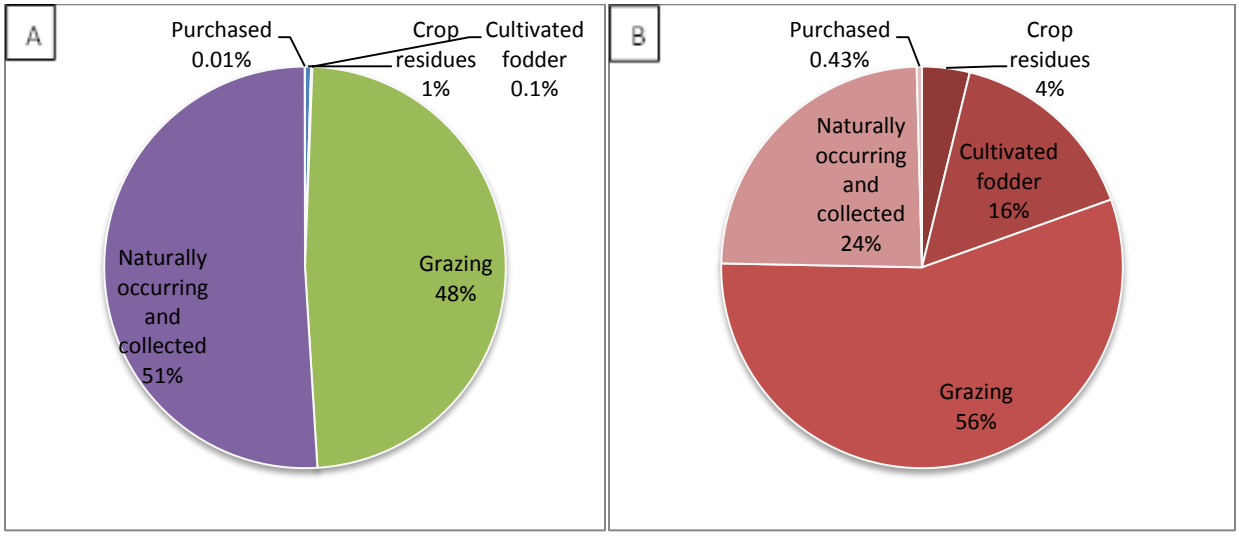


Figure 5: The contribution of feed resources to total metabolizable energy content of diets in Menz-Gera-Gera (A) and Angolela-Tera (B)

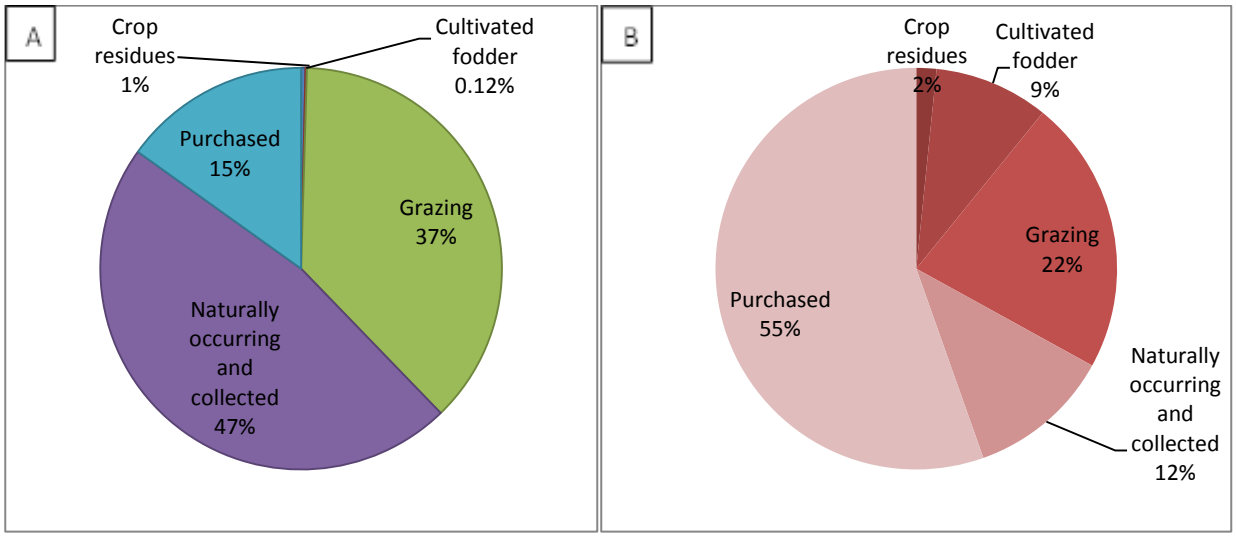
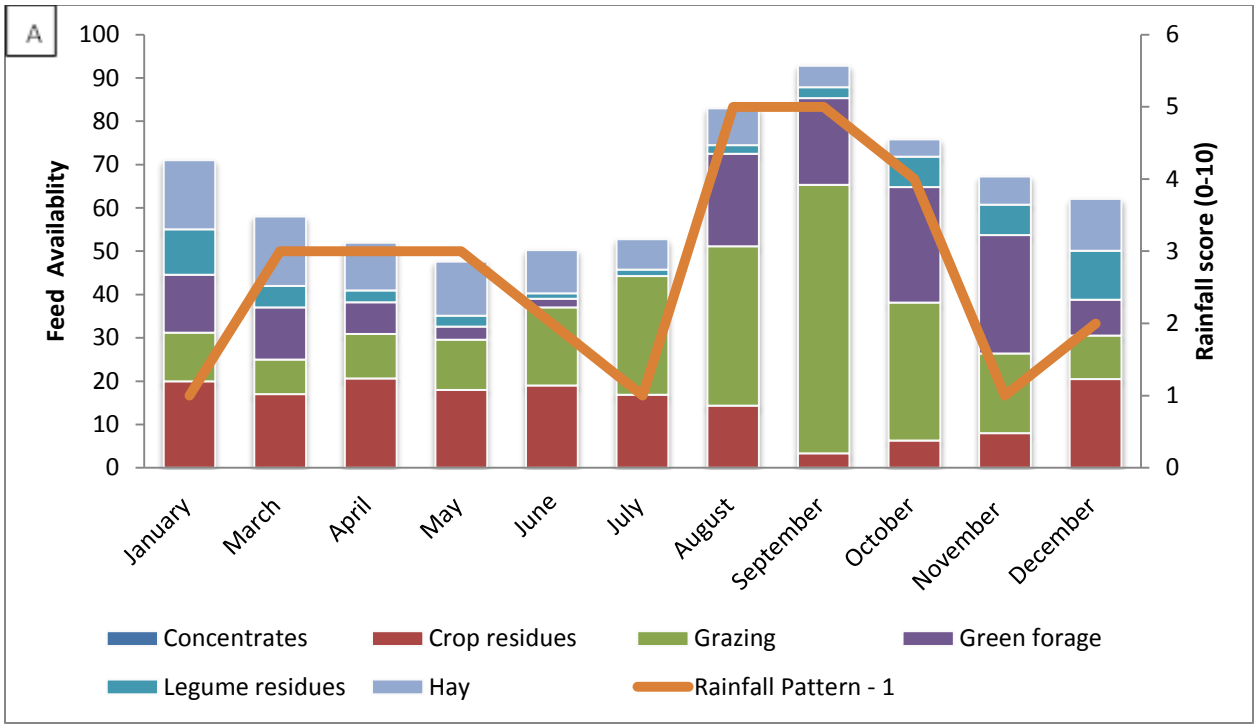


Figure 6: The contribution of feed resources to total crude protein content of diets in Menz-Gera-Gera (A) and Angolela-Tera (B)



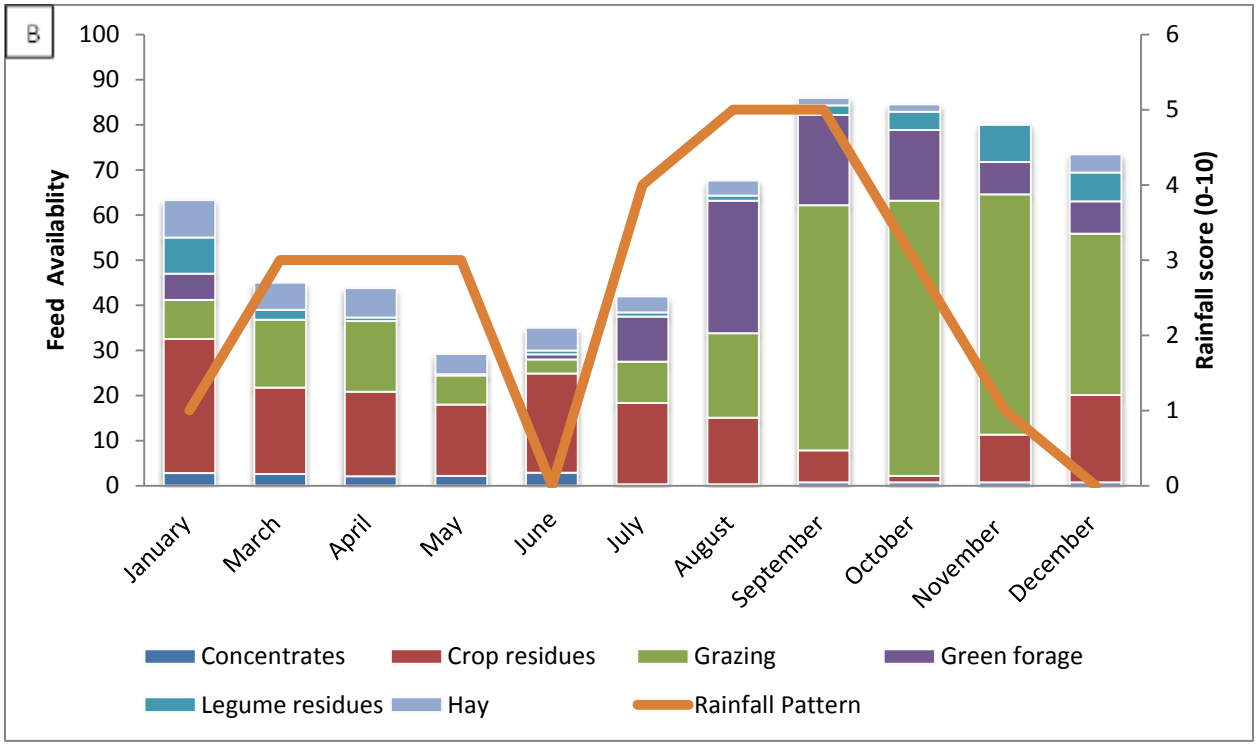


Figure 7: Seasonality of feed resource availability and their seasonal contribution to the total diet in Menz-Gera-Gera(A) and Angolela-Tera (B)

Problems, solutions, opportunities and issues

Livestock are a major source of livelihood in both districts. However, livestock production is constrained by a multitude of factors. The major problems and their priority ranking according to farmers are presented in Table 2. Feed shortage was identified by farmers as the most important problem in both districts. The subalpine highlands in Amhara region are characterized by high soil degradation, frosty and sub-moist climate and land shortage. Thus, there is poor grazing both in terms of availability and quality. The above characteristics also limit the development of planted forages and the availability of crop residues. However, there are opportunities for designing improved feed development and utilization strategies. Solutions proposed by farmers and existing opportunities and limitations for the three top ranking problems are presented in Table 3. Potential interventions are suggested considering proposed solutions from farmers and existing opportunities and limitations (Table 4).

Key issues

- Technological limitations: There are limited high yielding forage species adapted to the subalpine highlands. The ones currently in use (vetch and tree lucerne) are low yielders.
- Resource allocation: The root cause for the current feed shortage is the declining resources dedicated to livestock production. There is increasing "encroachment" of grazing resources, available lands being used for crop production and livestock being excluded from mountains due to soil conservation projects. There is also limited opportunity for the development of cultivated forage due to small land holdings.
- Disease, traditional breeding and management practices limit livestock productivity and hence income, resulting in less incentive for farmers to adopt improved technologies.
- Attitude of farmers towards livestock production: Livestock particularly sheep are kept virtually as scavengers with practically no input, though they are the major source of livelihoods.

Table 2: Farmers' rankings of the major problems constraining livestock production in Menz-Gera-Gera and Angolela-Tera

Problems (in order of importance)	Menz-Gera-Gera	Angolela-Tera
1	Feed shortage	Feed shortage
2	Disease	Disease
3	Uncontrolled breeding	Lack of management knowhow
4	Lack of Improved breeding stock	Lack of Improved breeding stock
5	Grazing land shortage	Grazing land shortage
6	Marketing	Marketing

Table 3: Proposed farmer solutions to prevailing problems and associated opportunities in Menz-Gera-Gera (A) and Angolela-Tera (B)

A

Problems	Farmers proposed solutions	Opportunities and limitations
Feed shortage	▪ Setting aside part of crop land for growing forages ▪ Improve forage seed supply; regulations to stop turning grazing lands into crop lands ▪ Timely collection and conserving feed for the dry season (hay and crop residues)	▪ Land holdings are too small even for food crop production in Menz-Gera region, but farmers expressed willingness to dedicate small plots for forage crops ▪ The available improved forage crops suitable to the subalpine ecology are limited to two species (vetch and tree Lucerne), thus there is an opportunity to increase biomass by introducing more and high yielding species Soil conservation structures are an important entry point to increase forage biomass where land for cultivated forages is limited. Grazing lands are increasingly being cultivated for growing food crops and livestock are being excluded from mountain closure areas with soil conservation structures. The opportunity to increase feed availability exists if a compromise policy and strategy for food crop production, soil conservation and livestock development is devised ▪ Farmers are willing to adopt improved sheep production technologies as they are the major source of livelihoods. Yet, conserved feeds (hay and crop residues) are used mainly for cows and oxen. Therefore training on rational utilization of feed resources is required. Technologies for improving quality are not exploited
Disease	Availing regular vaccination and spraying; improved feeding; accessibility to animal health service posts	Health service coverage is reasonably developed. However, they need to be well functioning in terms of providing quality services
Uncontrolled breeding	Applying recommended breeding seasons; herding male and females during off-season periods	Farmers have become aware of the need for controlled breeding. However, village conditions such as communal grazing do not allow for controlled breeding. Thus there is a need for research and development efforts to design appropriate village breeding programs

B

Problems	Farmers proposed solutions	Opportunities and limitations
Feed shortage	▪ Improving availability and access (affordable price) to commercial concentrates ▪ Setting aside part of crop land for growing forages ▪ Limiting herd size	▪ Availability of irrigation and conducive climate for feed development ▪ Existence of dairy cooperatives is an opportunity to provide input supplies such as concentrate feeds and seeds as well as milk sale at fair prices
Disease	▪ Genuine drug supply ▪ Availing regular vaccination ▪ Improved management and hygiene	▪ Veterinary services are well available. Regulation of private practices and quality and efficient services from public clinics is required
Lack of management / knowhow	▪ Improving extension service and applying expert advices ▪ Training and awareness creation	▪ Farmers are already aware of improved management intervention. Hence, a careful sociological study may reveal the real constraints to adopting improved management: is the factor lack of knowhow or resource limitation or tradition or specialization? ▪ Appropriate delivery of training is required

Table 4: Potential interventions derived from farmers solutions and existing opportunities

Problems identified by farmers	Menz-Gera-Gera	Angolela-Tera
Feed shortage	▪ Integration of forage tree with soil conservation ▪ Forage tree as live fences ▪ Crop residue treatment ▪ Crop residue-based rations ▪ Provision of concentrates through cooperatives ▪ Regulations and policy issues for grazing lands and their rehabilitation	▪ Cultivated forage ▪ Forage trees as live fences ▪ Crop residue treatment ▪ Crop residue-based rations
Disease	▪ Community-based health services ▪ Private health services (USAID model)*	▪ Private health services (USAID model)
Uncontrolled breeding	▪ Community-based cooperative breeding scheme	-

* USAID model: Training and equipping of community animal health workers (COHWS) in villages and provision of starting capital for private veterinary clinic entrepreneurs which are supposed to supply drugs for CAHWS

Conclusion

The subalpine highlands in Amhara region are dominated by smallholder subsistence mode of production. Livestock productivity is low due to a multitude of factors, despite sheep in Menz-Gera and sheep together with improved dairying in Angolela-Tera districts being a major source of livelihoods. Feed shortage is the most important problem affecting livestock production and there is limited improved feed development and utilization practice in the area. Furthermore, there are limited improved forage species adapted to the area and the available feed improvement technologies are not in use by farmers.

There are solutions and opportunities to reverse the current feed shortage in these areas. However, there are also limitations to introducing improved feed development interventions. The limitations or issues include land shortage, conflicts between different development strategies (e.g. soil conservation vs. livestock production) and farmers' subsistent mode of production. Thus, the strategy for improving availability and utilization of feeds needs to consider policy and strategic issues, beyond generating and disseminating livestock technologies.

Observations on FEAST

Strengths

- A holistic approach – FEAST considers resources, socio-economic status, cropping system and non-feed aspects of livestock systems.
- Tool can be used for a rapid appraisal of other aspects of livestock systems
- Integrates indigenous (participatory) and modern animal science knowledge and methods
- Enables rapid and facilitated data collection, analysis and interpretation
- FEAST is very friendly, also allows for the editing of basic parameters

Weaknesses

- Too small sample size: FEAST accommodates data from only six respondents for individual interviews, which is only two per wealth category. If data from more than six respondents is entered, FEAST gives error messages when trying to edit the information. Information from a single respondent from each wealth category in each sampling site (*Kebele* in the case of this study) is far from representative. The attempt to use a more representative data by doubling the number of respondents was not successful because of the limitation in FEAST.
- Contribution of farm activities to income: FEAST Excel template for contribution of sheep is limited to fattening sheep. This could be misleading to users as there are more important classes of sheep (such as yearlings).
- Some difficult questions – Trend data by month (e.g. milk yield, prices) are difficult for farmers to recall. Such data could be easier for farmers and more realistic if asked by season.

Way forward

- Beyond technical interventions: There is a need for a rational and a compromise approach for crop, natural resource (soil) conservation and livestock development strategy. The current recommendation of closing hillside grazing with soil conservation structures and of stall feeding of livestock may work for production systems with a few dairy cows or a few fattening animals. Even for such systems, forage development with a cut-and-carry system needs to be an integral component of the soil conservation projects from the onset. However, a different strategy may be required in production systems with large breeding flocks (which are the sole or main source of livelihoods) and fattening animals to intensive systems markets (which require large volume of supply e.g. Menz-Gera). Stall feeding in such areas does not work!
- Improvements in the value chain, particularly input supply and marketing of products are required so that farmers get their fair share of the value of their animals, which in turn acts as an incentive for adopting improved technologies. (For instance, Angolela-Tera farmers have a better feed development and utilization practice than Menz-Gera farmers because of their cooperative approach to input supply and marketing of their dairy products).

- A holistic approach: Problems that constrained livestock productivity (diseases and traditional breeding and management) and hence farmers income and incentives to adopt improved technologies that require resource reallocation (such as planted forage development) need to be considered along with feed technologies.
- Technical interventions: Introduction of high yielding forage species, exploiting feed treatment technologies to utilize the bulk of the feed resources (crop residues and hay) and farmer training.